



Dispersion modelling: From Australian Bush Fires to the Antarctic atmosphere

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Changing weather conditions in Australia imply larger risk for forest fires

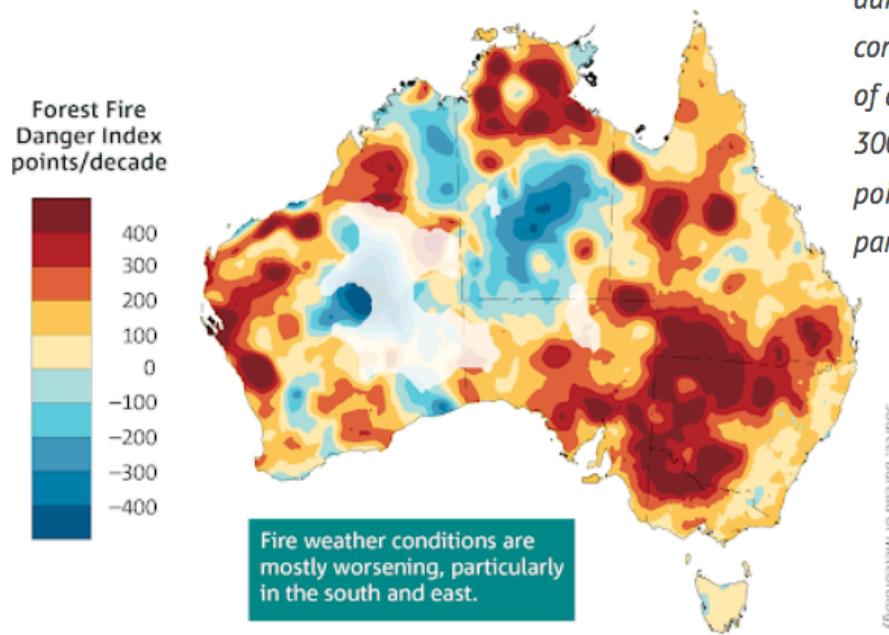


Figure 3: Trends from 1978 to 2017 in the annual (July to June) sum of the daily Forest Fire Danger Index—an indicator of the severity of fire weather conditions. Positive trends, shown in the yellow to red colours, are indicative of an increasing length and intensity of the fire weather season. A trend of 300 FFDI points per decade is equivalent to an average trend of 30 FFDI points per year. Areas where there are sparse data coverage such as central parts of Western Australia are faded. Source: BoM 2019b.

What is the impact of forest fires on the climate?



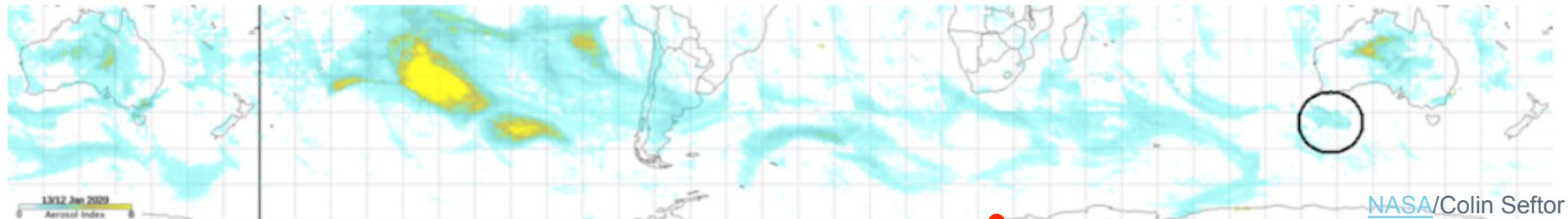
The *composition of the atmosphere* is an important factor for climate change

Forest fires emit biomass/smoke which moves through the atmosphere

Dispersion of smoke can be observed, or modelled with a dispersion model

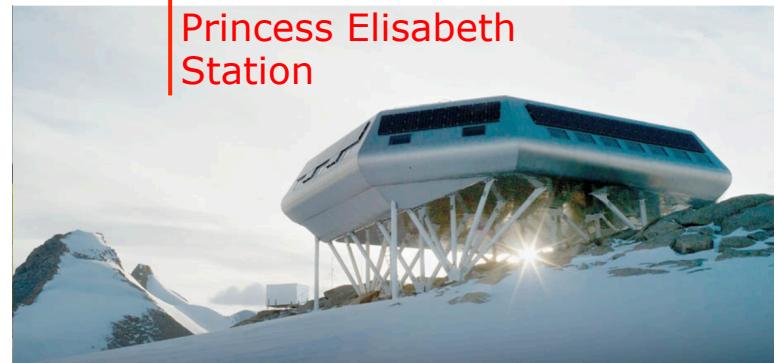
Australia
January 4, 2020
Image from [NASA](#)
(Aqua-MODIS)

Smoke reaching Antarctica can have an important impact on the climate



At the Princess Elisabeth Station in Antarctica the composition of the atmosphere is measured (e.g. the Chase and Aerocloud projects)

Does smoke from the Australian bush fires reach the Princess Elisabeth Station?



Project and main conclusion

Project:

Model the transport of smoke from the Australian bush fires
in the atmosphere

Predict the black carbon concentration at Antarctica

Main conclusion:

Black carbon is spread over the whole southern hemisphere

At the Princess Elisabeth station $0\text{--}1\mu\text{g}/\text{m}^2$ black carbon
is expected from modelling



Overview

Model setup and input data

Comparison results from the model with satellite data

Deposition in the southern hemisphere



Dispersion model and data used

Dispersion model

Lagrangian particle model Flexpart 9.02 in forward mode

Meteo input

3-hourly data with 0.5° resolution from ECMWF ERA-5

Input from biomass emissions

CAMS GFAS (Global Fire Assimilation System)

GFAS black carbon emissions from fire

Emissions included:

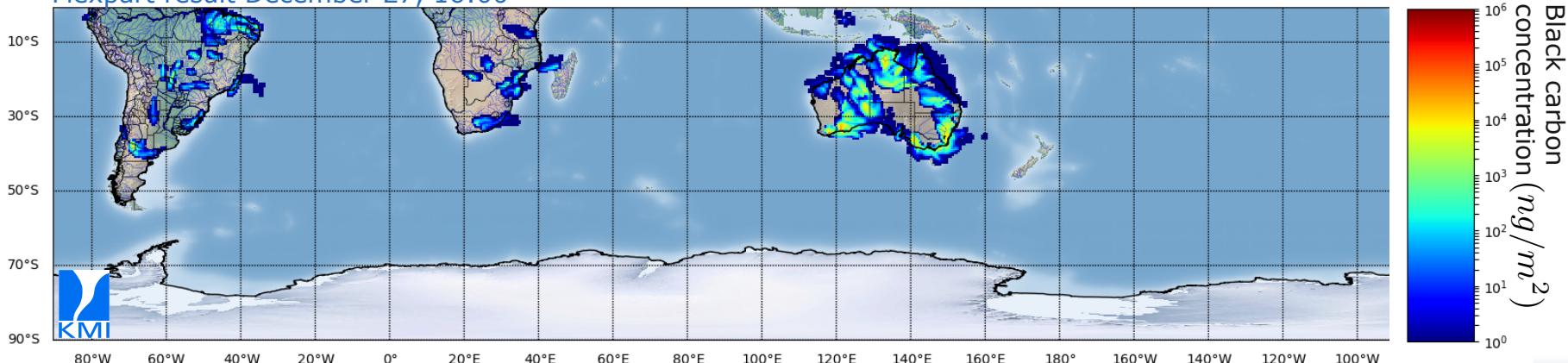
Black carbon

December 27, 2019 - January 7, 2020

Southern hemisphere

(= 11370 releases, 500 particles/release)

Flexpart result December 27, 16:00



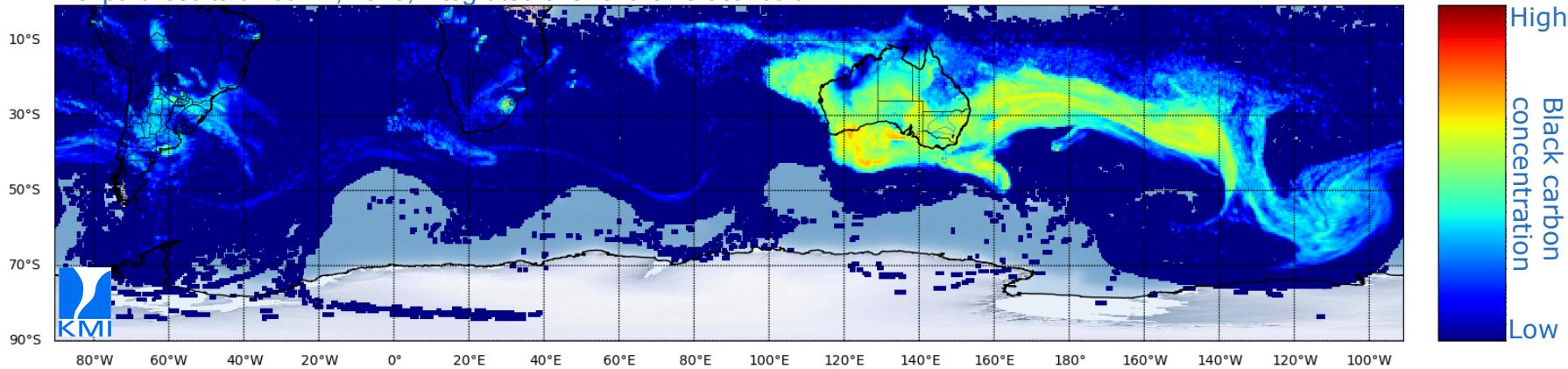
Flexpart on Australian bush fires

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Use Flexpart to model the dispersion in the atmosphere

Simulation from Dec 27, 2019 to Jan 31, 2020
No aging, convection included

Flexpart results on Jan 7, 2020, integrated over entire vertical column



Flexpart on Australian bush fires

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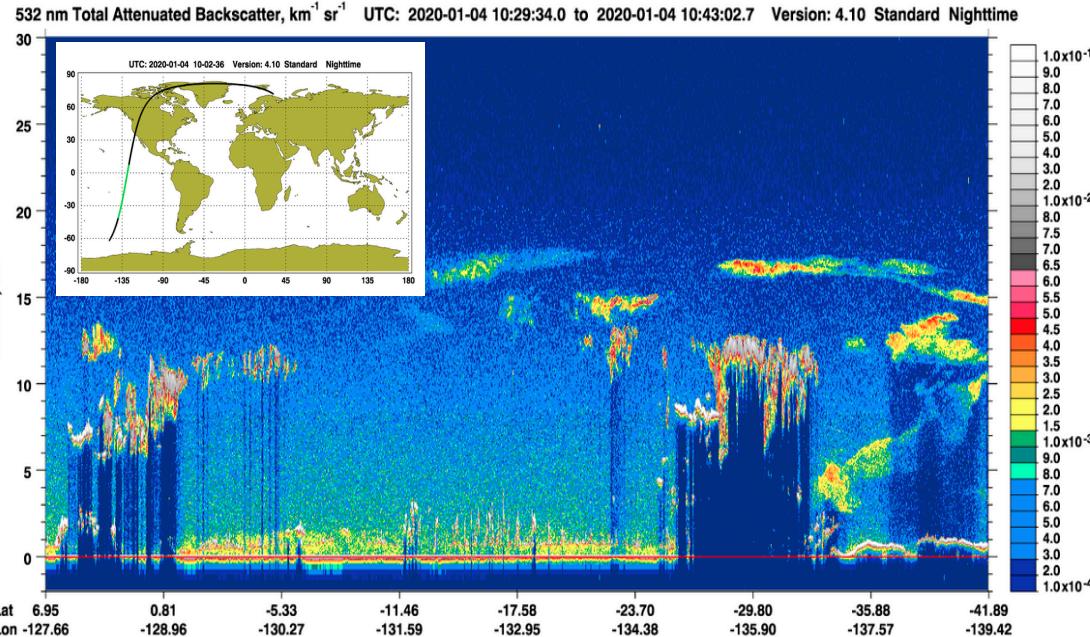
Model setup and input data

CAMS GFAS, ECMWF ERA-5, Flexpart 9.02

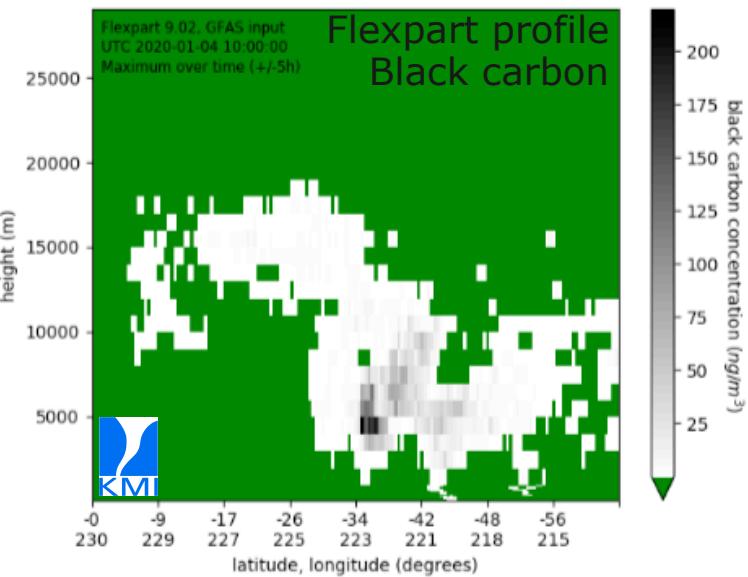
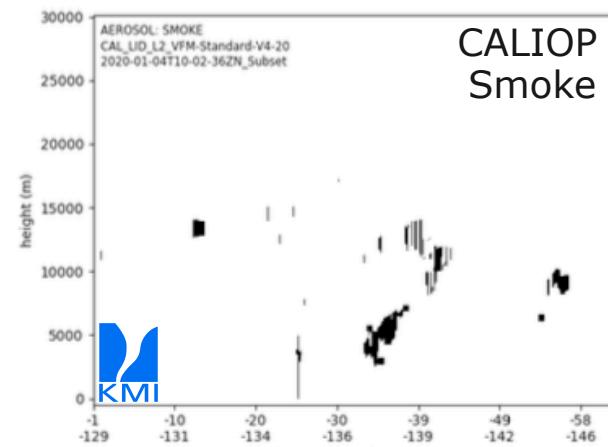
Comparison results from the model with satellite data

Deposition in the southern hemisphere

Flexpart results fit well with satellite data from CALIOP



Flexpart on Australian bush fires



Overview

Model setup and input data

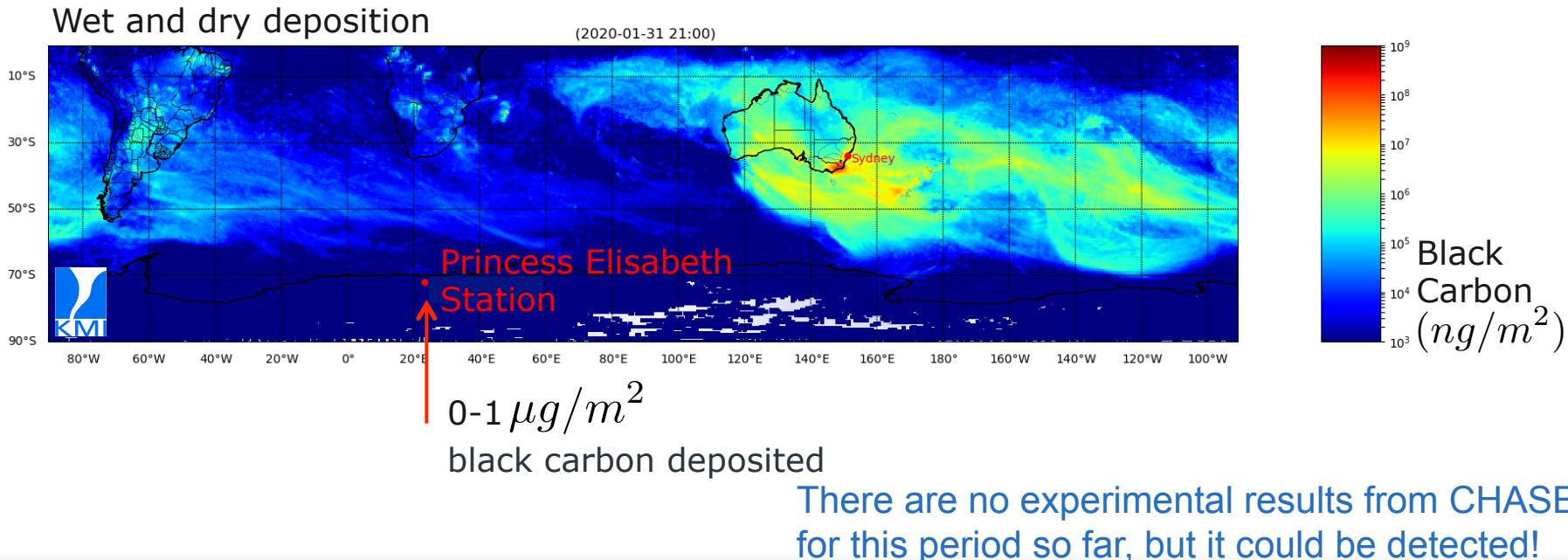
CAMS GFAS, ECMWF ERA-5, Flexpart 9.02

Comparison results from the model with satellite data

*Black carbon concentrations from Flexpart fit
quite well with CALIOP satellite data*

Deposition in the southern hemisphere

Black carbon reaches Princess Elisabeth and could be detected



Overview

Model setup and input data

CAMS GFAS, ECMWF ERA-5, Flexpart 9.02

Comparison results from the model with satellite data

*Black carbon concentrations from Flexpart fit
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Deposition in the southern hemisphere

*Black carbon spreads over the whole southern hemisphere
At the Princess Elisabeth station 0-1 µg/m² black carbon is expected from modelling*

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Thank you!

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